A Work Project, presented as part of the requirements for the Award of a Masters Degree in Economics from the Faculdade de Economia da Universidade Nova de Lisboa

EXPANSION OPPORTUNITIES IN THE EU POWER SECTOR FOR AN INTEGRATED POWER UTILITY BY 2025

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Expansion Opportunities in the EU Power Sector for an Integrated Power Utility by 2025

This project provides the identification of investment opportunities by 2025 in selected EU power markets for an integrated power utility. To be able to come up with a sound recommendation, it was essential to elaborate on key energy market trends as well as their implications and deep dive into selected markets. After coming across the potential investment opportunities, a simple financial model was developed through a detailed business case to provide quantification and translate potential risks or mitigations.

Keywords: Investment Opportunities, Power Utility, Energy Trends, Business Case

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1. Brief Context

a. Client

Our primary Client was The Boston Consulting Group (BCG), whose Project Leader played the role of a mid-sized integrated power utility based in Czech Republic[1].

The Client disposed of a budget of €250 million to invest in the EU power sector which he would prefer to split evenly among three opportunities, although other alternatives were also on the table, given solid discrimination and quantification.

The Team tried to abide to The Client's preferences which were stated throughout the process, especially when there were several alternatives to reach the desired outcome[2]. This, however, did not prevent The Team from enjoying substantial freedom in decision-making along all the stages of the project.

Contact with The Client occured through four meetings: two Jour Fixes (March 24th & May 2nd) and two Steering Commitees (April 8th & May 27th), with the former consisting of presentations to the Power Utility's Project Leader, while the latter dealt with a Partner of the company.

[1] Hereinafter referred to as "The Client"

[2] See Section 2 of the Work Project for examples of these interventions

b. Market Overview

The EU Energy landscape is undergoing a profound transformation. There are major changes happening across Europe both in the EU's targets and legislation and at a deeper country level.

A shift of generation mix towards RES[3] has been registered[4] (installed capacity & generated output) amplified by the 20-20-20 Goals[5], the wholesale price of electricity has been deteriorating consistently[i], new trends are breaking existing paradigmns (e.g. distributed energy, smart grids[6]) and energy efficiency is increasingly resulting in plateauing or decreasing power demand.[ii]

Examples at a country-level in legislation also follow these changes: in 2011 after events in Fukushima, Germany decided to phase out all its nuclear power plants until 2022[iii]. Two years after, Spain retroactively adjusts its Renewable Energy Sources support schemes rendering projects very tight on profitability[iv], whereas the UK, formerly a global offshore wind powerhouse, plans to cut former subsidies in the near future.[v]

All these changes are causing major utilities to lose ground, with a 15-55% drop in share prices registered throughout EU power companies since 2010[vi].

But while this dynamic environment might lead some companies into a loss, it also proves as an opportunity for those that foresee and anticipate these changes.

[3] Renewable Energy Sources

[4] See Figure 3: "Gross Electricity Generation in the EU" in Appendix A

[5] The 20-20-20 Package is a set of binding legislation to ensure the EU meets its climate and energy targets for the year 2020.

[6] A smart grid is an electrical grid which includes a variety of operational and energy measures including smart meters, smart appliances, renewable energy resources, and energy efficiency resources

c. Current Client Situation

As our Power Utility Client is hypothetical and has the purpose of mirroring a real-life situation, The Boston Consulting Group's current context will be discussed instead.

The Boston Consulting Group is an American worldwide management consulting firm with 85 offices in 48 countries and is considered one of the most prestigious management consulting firms[7].

In 2014, the company had 6,500 consultants and its revenue amounted to €4 billion[8].

The branch in the Czech Republic is also responsible for the Slovakian Market and has a team dedicated exlusively to energy, with whom we worked closely.

d. The Business Project Challenge

The project's design aims to closely resemble the work of a strategy consultancy and bring substantial learnings to The Team, while also providing useful output for BCG. As such, its content is a full-fledged mini-case work, by which students are expected to deliver on expectations of BCG's clients, including both breadth and depth.

The casework will encompass research activities, extracting information via interviews with BCG consultants, analysis of data, synthesis of insights into final recommendations, PowerPoint packaging and presentation of results in front of the final Steering Committee.

[7] Data provided by The Boston Consulting Group

[8] Ibid

2. Reflection on the Work Done and Individual Contribution

a. Problem Definition

The Energy Market in Europe is a highly complex and competitive market, with an endless stream of players along the value chain. Our challenge is how to proceed, starting from the entire width of the Market, in order to arrive at the company specific country-level investment opportunities?

In the next Section entitled "Methodology" we describe the process and reasoning chosen to address this problem and come up with the recommendations presented to The Client.

b. Methodology

i. Hypothesis[9]

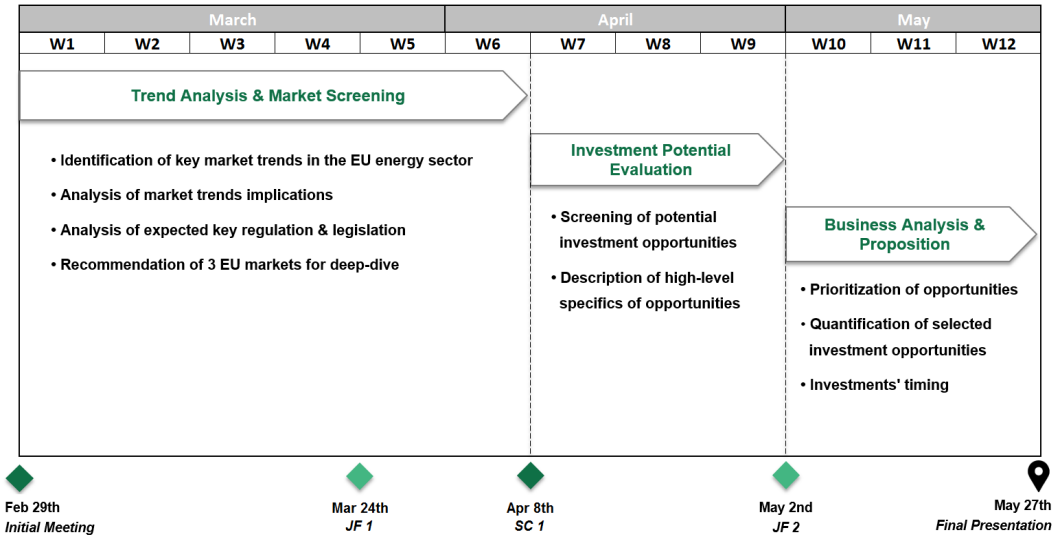
The new dynamics of the Energy Market in Europe show a growing installed capacity of renewables in most countries. This increase in generation through RES shows no sign of slowing down, with legislation and the need for sustainability as the main driving forces.

Our hypothesis and cornerstone for this project states that this upward trend in renewable energy generation will push conventionals out of the merit order, leading to its increase to levels where it becomes the main source of power in the EU-28 by 2030.

[9] For assumptions regarding the Business Case Financials see Section 2.b.

ii.Methodology

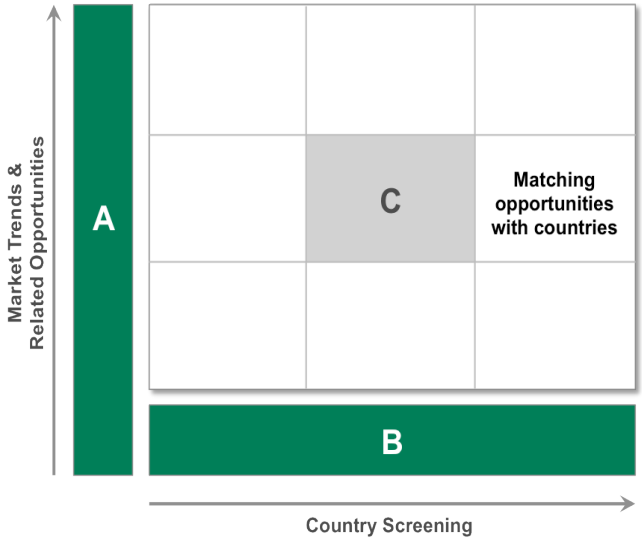
Table 1: *Gantt Chart encompassing development of the project*



The project went through three main stages in the course of 12 weeks. To select and quantify the most attractive investment opportunities, a well-fundamented and phased process to sequentially narrow the possibilities in a funnel-like approach was used.

The first Stage was conducted by resorting to a two-dimensional matrix-style approach demonstrated in Figure 1 that encompassed, firstly, the Identification of Market Trends & Related Opportunities in the energy market in Europe (Dimension A).

Figure 1: *Phase 1 Matching Matrix*

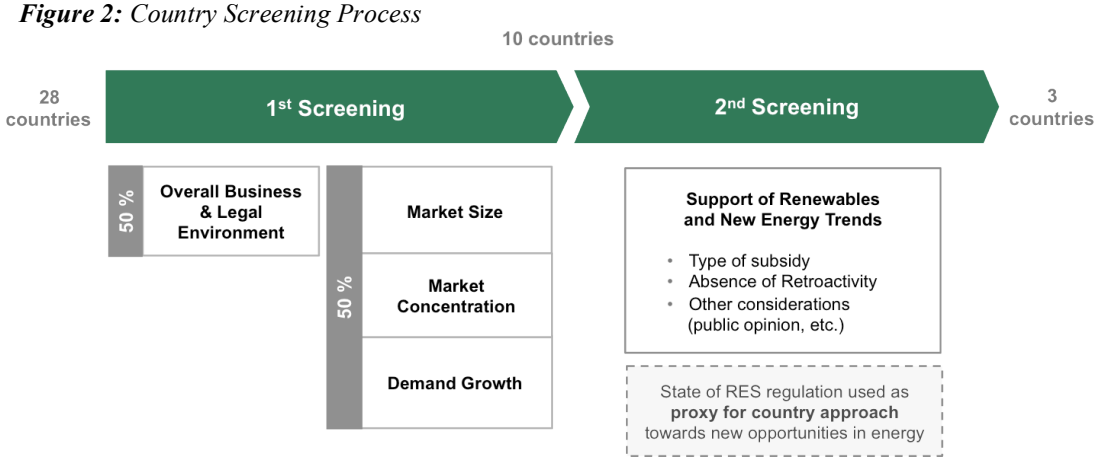


Five major trends were identified and subsequently ranked in market potential terms. From these, five investment opportunities were derived and ranked, one per each trend with the top-3 being chosen to be matched with the selected countries.

Secondly all EU-28 Countries were screened (Dimension B) in a two-step process ranking them in terms of their Overall Business & Legal Environment and Market Attractiveness with equal weights (see Figure 2 below). This left us with a list of ten countries which were then the subject of another evaluation, this time related to their legal support of Renewables.

This second step of the Country Screening Process eliminated seven countries, leaving us with the group of three into which we would deep-dive.

Figure 2: *Country Screening Process*



The second stage of the project had as objective the matching of the Identified Trends/Opportunities with the final group of countries. In order to do this all possibilities were looked at and through a thorough analysis and comparison of the markets, four possibilities were found and the subject of a high-level assessment.

In the end, two were deemed tangible and realistic, thus the subject of further analysis.

The final stage of the process had as output the quantification of the two selected opportunities through a detailed Business Case that discriminated the financials of the opportunity with the corresponding Return on Investment to be approved by the client.

iii. Analysis

Trend Analysis - Dimension A

The Key Market Trends in the energy sector with attractive investment opportunity areas that were identified were: *Renewables, ESCOs*[10]*, Smart Grids, Energy Storage and Electric Cars/Charging Stations*.

- The share of *Renewables* has been steadily growing[11] as a consequence of regulations, technological improvements and decreasing operating costs, thus pushing conventionals to the edge of the merit order[12];

- With electricity as a commodity reaching its potential, the energy players are moving to the services sector. The growing importance of efficiency in EU and country-level legislation leaves room for *ESCOs* to capture value;

- The shift in the generation mix towards Renewables will have a major impact on the grid due to their higher volatility[vii], as such the relevance of *Smart Grids* comes with the

[10] An energy service company or energy savings company (ESCO) is a commercial or non-profit business providing a broad range of energy solutions including designs and implementation of energy savings projects, retrofitting, etc.

[11] See Figure 3: "Gross Electricity Generation in the EU" in Appendix A

[12] See Figure 5: "RES and Merit Order" in Appendix A

need to accomodate these changes in peaks through improvements in the distribution infrastructure (Example of the mandatory rollout of Smart Meters for more than 80% of EU population by 2020[viii]) ;

- Costs of batteries have been decreasing steeply and the added flexibility/balancing to the grid makes *Energy Storage* an attractive investment opportunity[ix];

- Due to the increase in *Electric Vehicles,* charging stations are expected to increase from 1 million units in 2014 to 12.7 million by 2021[x].

In order to rank the obtained trends, specific opportunities were derived from each[13]. *Renewables*, *Efficiency (ESCOs)* and *Energy Storage* were ranked as the top-3 trends in Energy in Europe with specific opportunities also derived.

Starting with Renewables, it is clearly the biggest market with 16% of gross final energy consumption in the EU having been generated by RES in 2014[xi]. This trend can be decomposed into two opportunities: Building or Acquiring Solar Power Plants and/or Wind Farms.

Energy intensity in EU industry decreased by almost 19% between 2001 and 2011, whereas in order to meet the EU's 2020 Energy Efficiency Target, the scale of investment needed is around €100 billion per year[xii]. The related Investment Opportunity derived was the Acquisition and Operation of an Energy Service Company.

In third comes Energy Storage, where the technology advancements are starting to bring batteries into a profitable area. The option to combine solar and wind generation with

[13] See Table 3 in Appendix A for a detailed view on the ranking of Trends

storage should also be taken into consideration. As an opportunity, the Building or Acquisition of an Energy Storage Facility was identified.

The two remaining trends were deprioritized after being looked into for the reasons stated in Table 2.

Market Screening – Dimension B

In order to deep-dive into three markets, and with trend-specific opportunities already obtained, we needed to find out which countries were most suitable for the client's investment.

To get from the initial EU-28 Country a 1st Screening was run evaluating the group, firstly, by their Overall Business & Legal Environment. This variable was chosen mainly due to the Client's preference of markets that were controlled for Corruption, displayed a stable Rule of Law and showed Regulatory Quality. Then, and with equal weight, the country-specific energy markets were assessed based on Size (total electricity consumption), Concentration (generation, distribution, retail) and Growth (comparison of 2014 data with 2020 prediction) [14].

Through this process we shortlisted the top-10 countries: *Germany, France, Italy, Spain, United Kingdom, Sweden, Finland, Netherlands, Denmark* and *Poland,* alongside the other 18 countries which were not submitted to further analysis[15] (all countries presented in table 10 below).

[14] See Figure 4 in Appendix A for an expanded explanation on each variable of the first screening part

[15] See Table 4 in Appendix A for an expanded view on country-specific scores

Table 2: *EU-28 1st Step Country Ranking*

Country	Overal Business & Legal Environment	Market Atractiveness	Total	Ranking
Germany	10,4	2,57	12,61	1
France	6,50	1,75	8,25	2
Italy	6,20	0,70	6,90	3
Spain	5,17	1,50	6,67	4
United Kingdom	3,24	2,77	6,01	5
Sweden	2,59	2,76	5,35	6
Finland	1,57	2,88	4,44	7
Netherlands	1,58	2,69	4,27	8
Denmark	0,62	2,93	3,55	9
Poland	2,24	1,21	3,45	10
Austria	0,95	2,35	3,30	11
Belgium	0,95	2,16	3,11	12
Luxembourg	0,09	2,57	2,66	13
Ireland	0,15	2,38	2,53	14
Estonia	0,11	2,20	2,31	15
Czech Republic	0,58	1,46	2,04	16
Portugal	0,62	1,40	2,03	17
Lithuania	0,11	1,65	1,75	18
Latvia	0,10	1,36	1,47	19
Malta	0,02	1,43	1,45	20
Cyprus	0,00	1,36	1,36	21
Hungary	0,35	0,90	1,25	22
Slovenia	0,09	1,10	1,19	23
Slovakia	0,20	0,95	1,15	24
Croatia	0,22	0,51	0,73	25
Romania	0,53	0,18	0,70	26
Greece	0,61	0,00	0,61	27
Bulgaria	0,41	0,05	0,46	28

The results showed that Germany was, by far, the country with the best Overall Business & Legal Environment, which paired with its top position in the Power Market Attractiveness make it the number one country in the ranking[16]. Poland closes the list of ten countries that will be further looked into,[17] whereas countries that didn't make it into the final screening like Hungary or Romania, didn't do so due to the unfavorable Legal & Business Environment and the unattractiveness of their energy market place (markets too small, with high barriers to entry and/or highly saturated).

With the pool of ten countries that show a solid energy market place and stable business & legal environment obtained, renewable-specific national legislation was assessed

[16] To arrive at Score 1 and Score 2 Final Values, the lowest variable value was subtracted from all scores (eg:. if the lowest score was 5.5 in Market Size for a given country, then this value would become 0 and 5.5 would be subtracted from the remainder variables) in order to maintain absolute differences between countries

[17] A list of 10 countries was selected due to time constraints, as the differential in the sum of the two scores between Poland and Austria wouldn't be decisive in excluding the latter

as part of the second-step of the screening (due to our top-three trends being all renewable-based or associated).[18]

Here, countries that had shown retroactivity in their support schemes for RES (Italy and Spain) were not analyzed any further. This is due to the importance of Feed-In Tariffs[xiii] in the profitability of renewables. As homeowners, business owners, farmers and private investors are paid a cost-based price for the renewable electricity they supply to the grid, this enables diverse technologies (wind, solar, biogas, etc.) to be developed and provides investors a reasonable return.[19]

For the reason above, Sweden was also discarded due to the inexistence of Feed-in Tariffs mostly due the maturity of the wind generation market in the country. The UK's government has also been taking measures against RES with subsidy cuts by as much as 65% and is showing a change of focus to nuclear and capacity markets and as such was also deprioritized. Nuclear is also France's biggest source of power generation, which paired with the untranslated legislation made the country not integrate the final 3 countries.[20]

Furthermore, as the client had shown doubts in going into a Scandinavian market Denmark and Poland were also left out, with Denmark 's new government also having shown interest in cutting renewable support.

We were left with Germany, the Netherlands and Poland.

Germany, as the market with the biggest Renewable Generation, which displays the most opportunities due to an ambitious energy transition project (Energiewende), set to drive the RES market to 80% of generation by 2030. Furthermore, the Netherlands has a €4 billion subsidy (SDE+) and a high growth in RES, especially wind and solar, whereas Poland has had

[18] See Table 5 in Appendix A for a detailed support of renewables screening of the top-10 countries

[19] See Figure 5 in Appendix A to see the effects of Feed-ins in unbalancing the merit order

[20] Data from Res-legal

increasing governmental support and a well developed RES infrastructure paired with high wind potential[21].

Potential Investment Evaluation

Through a thorough analysis of each of the twelve possible match-ups and a discussion with the client, four opportunities were selected for a high-level assessment, these were: *Wind Power Plant Acquisition* in Poland, *Energy Storage Project* in Germany*, ESCO Acquisiton* and *Solar Plant Acquistion* in The Netherlands[22].

1) Wind Power Plant Acquisition in Poland[23]

With a total installed capacity of 4,978 MW at the end of 2015 and 1,145 MW in new onshore capacity just last year, Poland is the second market in Europe in terms of dynamics of wind energy development.

Furthermore, the electricity production in 2015 was of 10,041 GWh, a 40% increase compared to the year before. Added to this, there is a high level of public acceptance of wind farms, with 67% of respondents believing that RES should be supported by the Polish Government and with 72% preferring their homes to be supplied by wind energy.

Finally and more importantly, government support of wind is indeed quite significant due to the new RES Law (1 January 2016) assuring the continuancy of subsidies to this

[21] See Figure 6: "Wind Potential in Europe" in Appendix A

[22] Only the two pursued opportunities were described, for ESCOs in The Netherlands and Energy Storage in Germany see Appendix B

[23] Data from Poland Wind Energy Association 2015 Report

technology and the so-called Certificates of Origin mandating that 20% of companies' energy to be generated by RES.

Four Power Plants were presented as possibilities to the client: a 35 MW RWE Innogy Wind Farm in Tychowo, an 33 MW Acciona Wind Farm in Krobia, a 17 MW RWE Wind Farm in Opalenica and a 48,3 MW Polenergie Wind Farm Project in Gawlowice.

This last one was selected with the client for the Business Case due to its fitting size (MW).

2) Solar Power Plant Acquisition in the Netherlands

In 2014 solar's installed capacity grew by 50%, crossing the one-gigawatt threshold, with a registered increase of 1455% between 2010 and 2015, (CAGR of 74%).[24]

The government's support of solar highly favors investment, the SDE+ Scheme has a budget of €4 billion, with roughly a third of it being allocated to Solar Power[25]. Furthermore the net metering scheme is guaranteed until 2020 and several other supports exist like loans and various tax benefits (Ex: VTVCO, a scheme reduced tariff for collective production of renewable energy).

Several solar projects were identified (constructions ending in 2018): a 27.6 MW Solar Plant in Veendam, a 30 MW Solar Plant in Delfzij and a 15 MW Solar Plant in Leek.

The first two were deemed realistic opportunities due to their size and geographical proximity and were chosen to be the subject of a detailed and quantified analysis.

[24] Data taken from Photovoltaic Barometer 2016 Study carried out by EurObserv'Er

[25] Information available at SDE+ 2016 Brochure

Business Analysis/Proposition[26] & Recommendations to the Client

Table 3: *Gawlowice Wind Farm's Business Case*

Acqusition of MW	48,3
Cost MW/EUR	1 600 000
Acqusition cost EUR	77 280 000

Capacity factor	27%
Year production in MWh	114 239
Operating cost per MW/EUR	45 000

Discounted CF	107 021 467
Average annual ROI	**9,2%**

Year	Price EUR/MWh	Revenue in EUR	Operating costs	Profit	Year	Discount rate	Time value of money
2018	90	10 281 524	2 173 500	8 108 024	1	1,01	8 027 747
2019	89,5	10 224 405	2 173 500	8 050 905	2	1,01	7 892 270
2020	89	10 167 285	2 173 500	7 993 785	3	1,01	7 758 689
2021	88,5	10 110 166	2 173 500	7 936 666	4	1,01	7 626 980
2022	88	10 053 046	2 173 500	7 879 546	5	1,01	7 497 118
2023	87,5	9 995 927	2 173 500	7 822 427	6	1,01	7 369 080
2024	87	9 938 807	2 173 500	7 765 307	7	1,01	7 242 842
2025	86,5	9 881 687	2 173 500	7 708 187	8	1,01	7 118 382
2026	86	9 824 568	2 173 500	7 651 068	9	1,01	6 995 676
2027	85,5	9 767 448	2 173 500	7 593 948	10	1,01	6 874 702
2028	85	9 710 329	2 173 500	7 536 829	11	1,01	6 755 438
2029	84,5	9 653 209	2 173 500	7 479 709	12	1,01	6 637 862
2030	84	9 596 089	2 173 500	7 422 589	13	1,01	6 521 952
2031	83,5	9 538 970	2 173 500	7 365 470	14	1,01	6 407 686
2032	83	9 481 850	2 173 500	7 308 350	15	1,01	6 295 044

Table 4: *Delfzij & Veendam Solar Plants' Business Case*

Acqusition of MW	57,6
Cost MW/EUR	1 100 000
Acqusition cost EUR	63 360 000

Capacity factor	17%
Year production in MWh	85 778
Operating cost per MW/EUR	27 260

Discounted CF	102 394 220
Average annual ROI	**8,1%**

Year	Price EUR/MWh	Revenue in EUR	Operating costs	Profit	Year	Discount rate	Time value of money
2018	120	10 293 350	1 570 176	8 723 174	1	1,01	8 636 806
2019	119,5	10 250 461	1 570 176	8 680 285	2	1,01	8 509 250
2020	119	10 207 572	1 570 176	8 637 396	3	1,01	8 383 372
2021	118,5	10 164 684	1 570 176	8 594 508	4	1,01	8 259 153
2022	118	10 121 795	1 570 176	8 551 619	5	1,01	8 136 572
2023	117,5	10 078 906	1 570 176	8 508 730	6	1,01	8 015 608
2024	117	10 036 017	1 570 176	8 465 841	7	1,01	7 896 242
2025	116,5	9 993 128	1 570 176	8 422 952	8	1,01	7 778 455
2026	116	9 950 239	1 570 176	8 380 063	9	1,01	7 662 225
2027	115,5	9 907 350	1 570 176	8 337 174	10	1,01	7 547 535
2028	115	9 864 461	1 570 176	8 294 285	11	1,01	7 434 364
2029	114,5	9 821 572	1 570 176	8 251 396	12	1,01	7 322 695
2030	30	2 573 338	1 570 176	1 003 162	13	1,01	881 441
2031	30	2 573 338	1 570 176	1 003 162	14	1,01	872 713
2032	30	2 573 338	1 570 176	1 003 162	15	1,01	864 073
2033	30	2 573 338	1 570 176	1 003 162	16	1,01	855 518
2034	30	2 573 338	1 570 176	1 003 162	17	1,01	847 047
2035	30	2 573 338	1 570 176	1 003 162	18	1,01	838 660
2036	30	2 573 338	1 570 176	1 003 162	19	1,01	830 357
2037	30	2 573 338	1 570 176	1 003 162	20	1,01	822 136

Our final output to the client, The Business Case for the Gawlowice Wind Farm and the Delfzij/Veendam Solar Plant, yields a ROI of 9.2% and 8.1% respectively[27], which are above industry average's of 7.2%.[xiv]

[26] Data from The Boston Consulting group

Worth mentioning the cheapest Cost per MW of Solar (€1,1 million) compared to Wind (€1,6 million), which along with its smaller operating costs make it a cheaper technology than wind. Yet, the project's long span, beyong the regulated period of 2030[28] drive its revenues down in later years, bringing its Average Annual Return on Investment to a value lower than wind's.

The capacity factor was assumed to be the industry's average, while operating costs were assumed to be constant. The Discount Rate and Cost per MW were provided by the BCG Consultants.

We recommend the immediate pursuit of these two opportunities to The Client, while keeping the ESCO Market in the Netherlands and Energy Storage in Germany on the watchlist for future analysis.

c. Concerns

Our main concerns in the pursuit of the investment opportunities are firstly, a change in legislation. Example of Czech Republic and Spain in 2010, whose cuts to feed-in-tariffs for already established solar projects by up to 45% undercut the rationale of having invested in those projects, cutting their returns substantially.

Furthermore climate change and unpredictable weather patterns can cause output shortfalls and volatile returns. For instance, the Capacity Factor assumed for either the Solar or Wind Business Case holds substantial relevance in the revenue, as such, a shortage in

[27] Prices calculated based on Country's 2016 Feed-in-Tariffs

[28] Information available at SDE+ 2016 Brochure

generation compared to its predicted value would drive the project's profitability down significantly.

e. Individual Contribution

As a team of three, we tried to evenly share the workload throughout the several phases of the project, although we also tried to adapt the project to our composition.

Initially, when we were coming up with the methodology and the scope of the market was wider, brainstorming and sharing ideas was crucial. But further ahead, as we dug deeper and information was much more specific and hard to uncover, the team saw the need to divide the work based on areas of expertise. During this time each group member's contribution is much better delimited and easier to define.

Going through each phase, the author's contribution to the project during methodology development was the conception of the Two-Step Country Screening Process[29], after coming across EY's Annual RECAI Report[30]. Although initially planned as a same-level assessment of all variables, the time and workforce constraints led to its separation into two steps so as not to analyse all EU-28 countries across both Business & Legal Environment, Market Attractiveness & Renewable Legislation Support.

During this phase it fell on the author to look up the Countries' legislation towards Renewables, which encompassed the assessment of their support for RES or lack thereof:

[29] See Section 2.b.ii: "Analysis"

[30] Renewable Energy Country Attractiveness Index

Feed-in Tariffs, Subsidies, Loans and Quotas. Alongside the reasoning for the chosen countries and for leaving out the other seven[31].

Concerning the Identification of Trends, the author's main output related to Smart Grids, Energy Storage and Electric Cars (which despite making up three out of five trends, each of these is of considerable smaller size and complexity than Renewables or Efficiency).

The matching of opportunities was also divided amongst the team members, with the Author arriving at the potential investment opportunity of ESCOs in the Netherlands and Solar Power in The Netherlands. Although only the latter was validated for the business case, the deprioritization of the former happened due to intensive research of over 20 annual reports of Energy Service Companies in the Netherlands, also the product of the Author's work.

Finally, the development of the Veendam & Delfzij Solar Power Plants Business Case were also at the responsibility of The Author.

3. Academic Discussion

a. Possible links with your MSc field (Economics, Finance, Management)

To start from a scope as wide as the whole Energy Market and decide, firstly, which countries should be selected for a deeper analysis required a Macroeconomic Approach, with the analysis of Country Indexes such as Economic Freedom, Corruption, Regulatory Quality, Rule of Law, amongst others. An approach that belongs to Industrial Organization Economics by Chamberlin (1933).

[31] See Table Table 4: "Top-10 Country Renewable Legislation Screening" in Appendix A

An overview of Industrial Organization was also resorted to when measuring the size and concentration of markets during the country-screening phase[xv], whereas a microeconomic approach of IO to explain internal firm organization and market strategy to find specific opportunities was also used[xvi].

The project also dealt with some issues of Corporate Financial Management, namely Business Valuation for the quantification of the investment opportunities.

Resorting to the Income Approach, discounted future cash flows were computed through the concept of the time value of money in order to properly value the proposed projects.

Finally, in the field of Business Strategy, Core Competencies introduced by C. K. Prahalad and Hamel (1990) and The Business Model by Al-Debei, El-Haddadeh and Avison (2008) were also glanced at in order to assess the viability of specific markets and industries like Solar in the Netherlands or Energy Storage in Germany.

b. Relevant theories and empirical studies

One of the variables used to narrow our scope from the EU-28 Countries to the Top-10 was Market Concentration, divided through the Value Chain as described by Porter (1985), into Generation, Distribution and Retail Concentration, while in the Five Forces Analysis[32] described by Porter (1979), Firm Concentration is a potential determinant of Industry Rivalry.

Given more time and resources, a way to further consolidate our findings (or arrive at different ones) and provide a more in-depth analysis would have been the integration of the

[32] Porter's five forces analysis is a framework that attempts to analyze the level of competition within an industry and business strategy development. It draws upon industrial organization (economics to derive five forces that determine the competitive intensity and therefore attractiveness (profitability) of an Industry.

remaining Five Forces into the methodology. A brief analysis directed at Power Generation, according to framework is presented below:

Industry Rivalry

Already mentioned in our project through the analysis of firm concentration, the European Power Market is highly concentrated in Generation terms, with Germany's biggest power utility having 32% of market share, Sweden's 43%, while France is around 87% and some countries even have a natural monopoly like Malta.[33] Competitive advantage relies mostly in cost due to the commodity nature of Energy.

Threat of New Entrants

Vogelsang (2004) describes the need of new entrants to utilize established assets like in the case of Distribution and Transmission resulting in exarcerbated costs that are prone to to the lingering of monopolies. Whereas this is not the case for generation, Sloman (2007) shows that high fixed costs associated with entering the market as a Generator are still considerable. Achieving Brand Recognition and Consumers' Trust, as well as the need for distributor agreements and difficulty to gain regulatory approval to build new plants also serve as barriers to entry.

Threat of Substitutes

If we were to separate Markets between Conventional and Renewable Energy Sources, then the former is and will continue to be very much threatened by the latter in the near

[33] See Table 4: "Scores and Ranking for the 28 EU Countries" in Appendix A

future[34]. In Awerbuch (2003) several benefits of RES regarding sustainability, price stability and operating costs compared to conventionals are described, while we can also look at it from the perspective of each technology like Nuclear or Wind would show all the other technologies available as substitutes, each with their benefits and disadvantages. Looking at the unified market as presented on section 2 would leave us with no substitute, as power is a necessity with an inelastic short-term demand.

Bargaining Power of Suppliers

According to Bielecki & Geboye Desta (2004) there are only a few power systems suppliers in Europe, who due to the low competition amongst them hold considerable power over the generation companies[xvii].

Bargaining Power of Buyers

Following Ahmad & Hassan (2016), innovations in technology like Smart Grids led to the subsequent rise of the role of the Prosumer, a term coined by Toffler (1980). In this case, the concept means that consumers can now also generate their own power (through household solar panels for instance). This offers them the opportunity to stay out of the grid, thus shifting the balance of power towards buyers. Adding to this, due to Electricity being an indifferentiated good it can therefore be treated as a commodity, leading buyers to seek out better prices and contract terms from utilities.

Adding to the Five Forces, a relevant extension to the framework by Branderburguer & Nalebuff (1995) who included the concept of complementors (the sixth force) as the impact of related products and services already in the market would be of extreme importance to

[34] See Figure 3: "Gross Electricity Generation in the EU" in Appendix A

consolidate our findings[35], as Energy Storage for instance is a direct complementor to renewable generation whose joint effects raise both parts' profitability.

Several empirical studies about the topic of renewable investment show very contrasting positions: Dinica, (2006) and Masini & Menichetti (2012) criticize approaches with the underlying assumption of legislation being the main driver behind Renewable Investment, which was the one we used. Defending, instead that further analysis of investors' behaviour and actions is due so as to establish more solid patterns for future research.

On the other hand, Awerbuch (2000) and Bhattacharya & Kojima (2012) argue that the hidden costs of fossil fuels, like the National Security Impacts of the reliance of Middle East oil and the consequent price shocks or shortages, associated with the more stable energy prices and the RES amenities requiring a less amount of maintenance, make investments in RES more attractive than in Conventional Sources of Power which falls in line with our findings.

c. Implications for theory and future research

Successfully identifying investment opportunities in renewables and the methodology of the project is based in the recognition of patterns or "connecting the dots" approach described by Baron (2006). But while several research and frameworks prove relevant in this sector like the aforementioned opportunity search or the Life-Cycle Cost Analysis, helping investors break through in some industries, these and others could be adapted to the renewable sector to assist more efficiently in challenges like ours.

An example of this would lead us back to the Branderburguer & Nalebuff's (1995) extension of the Porter's Five Forces. This framework could be especially relevant if we

[35] See the next section for for further development of this topic

considered the sixth force to be The Government, an idea that was refuted by Porter (2008), where he stated that the "Government is not best understood as a sixth force because government involvement is neither inherently good nor bad for industry profitability".

While this criticism makes sense in some industries, the fact is that without Legal Support such as Feed-in Tariffs or Subsidies, Renewables cannot compete with Conventionals, thus making government involvement a well-defined variable in RES profitability.

Concluding, the complex yet differentiated context of the RES Sector leaves room for revisiting and reinventing past theory, while there are still several sub-sectors that require the attentive eye of academia like Energy Services where the lack of both market and theoretical information led us away from what could have been a very interesting investment opportunity.

4. Personal Reflection

a. Personal experience

i. Key Strengths & Weaknesses observable during the project

Working in a team has been a crucial part of our lives as students in Nova and will continue to be in the near future all the same, as managers.

The project was very work-intensive, we spent around 600 hours together, yet during all this time I was more productive and more satisfied with my work. This illustrates both a strength and weakness: ability/preference for working in-group and (mildly) reduced productivity when working alone. These synergies can be explained by the added incentives

of doing a task better and quicker due to the presence and immediate evaluation of my peers. This Work Project proves a good chance to work on this weakness.

More than once, the project reached a point where there seemed to be no way to find the information needed to proceed, more than twice did we dig deep in company's material or whole markets just to find that was not the way to go. During these times, giving into despair or becoming discouraged woulde have been easy, yet would bring absolutely no added value to the work. This is something I was told by my father once and tried to incorporate in my life ever since. Keeping rationality and determination, as well as not stopping until solutions were found proved key strengths I demonstrated during the project, although the latter in no higher proportion than my colleagues.

Other strengths were punctuality and the display of a result-oriented mindset, while other witnessed weaknesses were lack of prioritization of content over form[36], which can lead to time constraints, and will to go through tasks chronologically which, just like in an exam, might not always be the most efficient way to go.

ii. Plan to develop of your areas of improvement

Out of the weaknesses stated, the one I would like to improve on sooner and the most is my diminished productivity when alone which I plan on solving by starting my career abroad, outside the comfort zone and with less (at least presential) support from friends and family.

The importance given to presentation is something I am already working on right now as I have witnessed through my peers that these are changes that can be done in the end after

[36] I wanted to be an Architect and still give a lot of relevance to design

content is thorough and solid. The same applies to the will to go through the work chronologically.

b. Benefit of hindsight:

Looking back at the project's development I'd say I added the most value through Creative Thinking as sometimes the best solutions aren't attained by following the paved road, Presentation Savvy as the project demanded several meetings with The Client where the team would present their output so far, and Research, which accounted for the majority of the work load. Despite the strict requirements and intensity of the project, the process was relatively smooth and we managed to deliver the desired outcome in time. Yet, of course if I knew what I know now there were situations that would have proved much easier.

We (as I know the team would agree) would not have spent so long on lost causes like the ESCO Market in The Netherlands, but accepted earlier on that there had to be a better way, thus saving us time and energy. Adding to this, we would be more pragmatic quantifying our assumptions from the start, avoiding a huge amount of effort later on due to the accumulated axioms derived from them.

The biggest asset would have been an earlier adoption of the attained funnel-like process to go from the big pool of data to the intended output, and use it from the start. This would have shortened the first phase considerably, which accounted for half the duration of the whole process.

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Appendix A - Graphs, Tables & Figures

Figure 3: *Gross Electricity Generation in the EU*

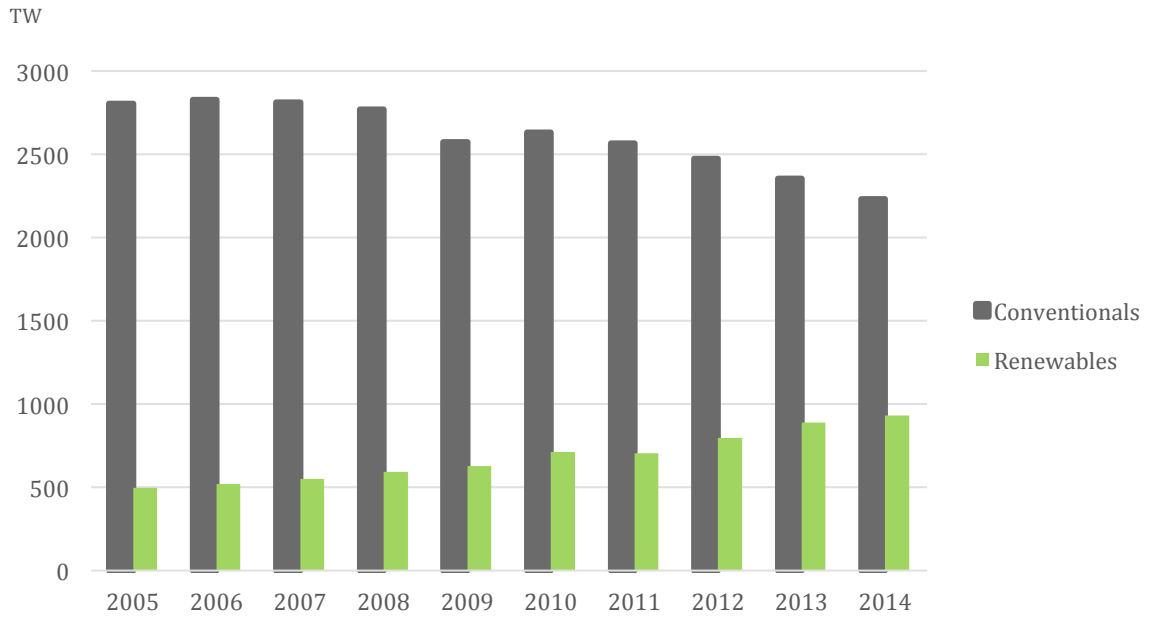


Figure 4: *1st Screening Variables*

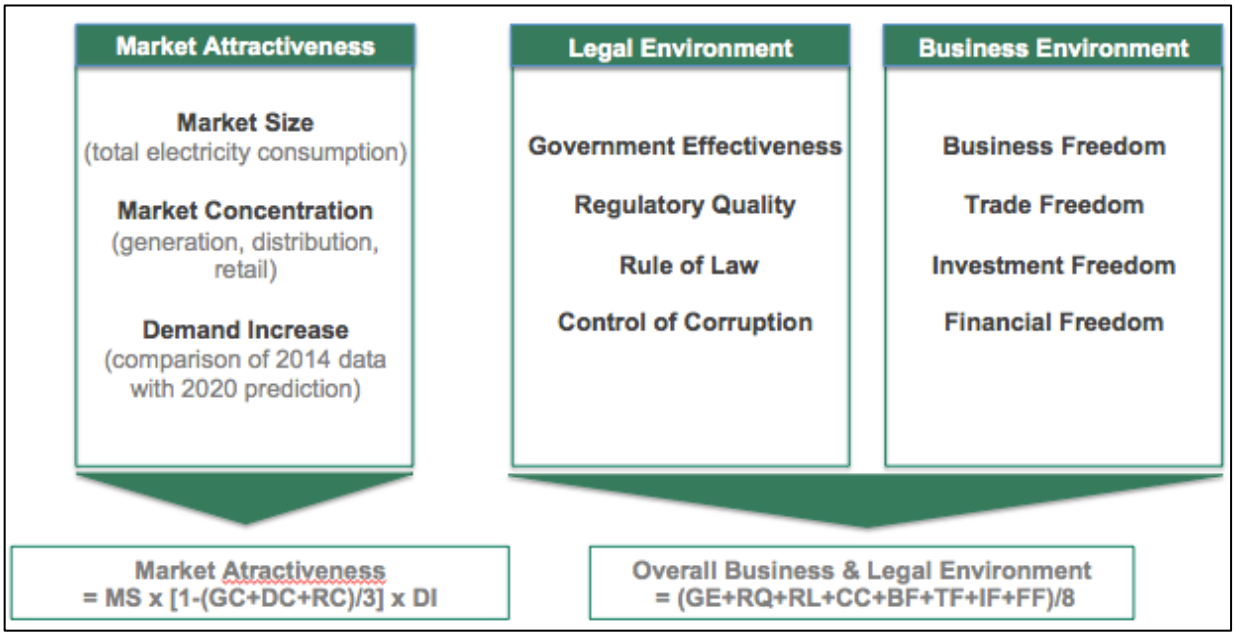


Table 4: *Scores and Ranking for the 28 EU Countries*

Country	MS	GC	DC	RC	DI	Score 1	GE	RQ	RL	CC	BF	TF	IF	FF	Score 2	TOTAL
Germany	10,00	0,32	0,09	0,00	1,16	10,04	94,71	94,23	93,27	94,71	90,00	88,00	90,00	70,00	2,57	12,61
France	8,10	0,87	0,03	0,01	1,15	6,50	88,94	82,21	88,46	87,98	78,40	83,00	70,00	70,00	1,75	8,25
Italy	5,49	0,29	0,01	0,00	1,26	6,20	66,83	72,60	66,83	55,29	70,30	88,00	85,00	60,00	0,70	6,90
Spain	4,42	0,24	0,01	0,02	1,28	5,17	84,62	75,48	79,81	70,19	76,00	88,00	85,00	70,00	1,50	6,67
United Kingdom	5,92	0,29	1,00	0,19	1,08	3,24	95,67	96,15	97,60	97,60	86,00	88,00	90,00	80,00	2,77	6,01
Sweden	2,38	0,43	0,03	0,03	1,30	2,59	95,67	96,15	97,60	97,60	89,70	88,00	85,00	80,00	2,76	5,35
Finland	1,54	0,25	0,08	0,04	1,16	1,57	99,04	98,56	100,00	98,08	90,70	88,00	85,00	80,00	2,88	4,44
Netherlands	1,98	0,21	0,73	0,09	1,22	1,58	97,60	95,67	97,12	95,67	80,00	88,00	90,00	80,00	2,69	4,27
Denmark	0,60	0,37	0,08	0,00	1,22	0,62	96,15	94,71	99,52	99,52	95,40	88,00	90,00	80,00	2,93	3,55
Poland	2,45	0,18	0,03	0,06	1,00	2,24	74,52	81,73	77,40	70,67	68,70	88,00	75,00	70,00	1,21	3,45
Austria	1,18	0,56	0,09	0,03	1,04	0,95	91,35	91,35	96,63	90,38	79,40	88,00	90,00	70,00	2,35	3,30
Belgium	1,57	0,60	0,63	0,12	1,09	0,95	88,46	85,10	88,94	91,35	85,40	88,00	85,00	70,00	2,16	3,11
Luxembourg	0,12	0,61	0,17	0,36	1,20	0,09	93,27	92,79	95,67	96,63	73,70	88,00	95,00	80,00	2,57	2,66
Ireland	0,47	0,51	1,00	0,67	1,13	0,15	92,31	95,19	92,79	91,83	79,60	88,00	90,00	70,00	2,38	2,53
Estonia	0,13	0,85	0,03	0,02	1,12	0,11	81,25	93,27	86,54	87,50	79,00	88,00	90,00	80,00	2,20	2,31
Czech Republic	1,10	0,58	1,00	0,01	1,12	0,58	80,29	81,25	84,62	65,38	66,60	88,00	80,00	80,00	1,46	2,04
Portugal	0,88	0,47	0,23	0,40	1,11	0,62	79,81	75,00	84,13	79,33	85,30	88,00	70,00	60,00	1,40	2,03
Lithuania	0,18	0,21	1,00	0,19	1,10	0,11	78,85	87,02	78,37	68,75	80,00	88,00	80,00	80,00	1,65	1,75
Latvia	0,13	0,55	0,09	0,33	1,17	0,10	77,88	84,62	77,88	66,35	78,60	88,00	85,00	60,00	1,36	1,47
Malta	0,04	1,00	0,00	1,00	1,78	0,02	80,77	83,17	86,06	78,85	61,60	88,00	85,00	60,00	1,43	1,45
Cyprus	0,08	1,00	1,00	1,00	1,16	0,00	83,17	82,69	82,21	82,21	74,50	88,00	75,00	50,00	1,36	1,36
Hungary	0,68	0,54	1,00	0,09	1,12	0,35	72,12	74,52	70,67	60,58	70,60	88,00	75,00	70,00	0,90	1,25
Slovenia	0,24	0,52	1,00	0,62	1,23	0,09	79,33	73,08	80,29	74,52	82,00	88,00	70,00	50,00	1,10	1,19
Slovakia	0,47	0,82	1,00	0,06	1,15	0,20	75,48	78,85	69,23	60,10	68,40	88,00	75,00	70,00	0,95	1,15
Croatia	0,29	0,80	0,00	0,22	1,14	0,22	73,56	65,87	65,87	62,02	60,30	87,40	75,00	60,00	0,51	0,73
Romania	0,82	0,30	1,00	0,09	1,20	0,53	55,77	71,63	63,46	53,37	66,10	88,00	75,00	50,00	0,18	0,70
Greece	0,97	0,72	0,50	0,09	1,12	0,61	68,75	64,90	67,31	51,44	73,80	83,00	60,00	40,00	0,00	0,61
Bulgaria	0,54	0,00	0,75	0,33	1,20	0,41	57,69	71,15	55,77	48,56	66,90	88,00	65,00	60,00	0,05	0,46

Source: Data from European Union, Heritage & World Bank

Concentration shows firm with highest market share (ex: Germany's biggest player in generation holds a market share of 32%)

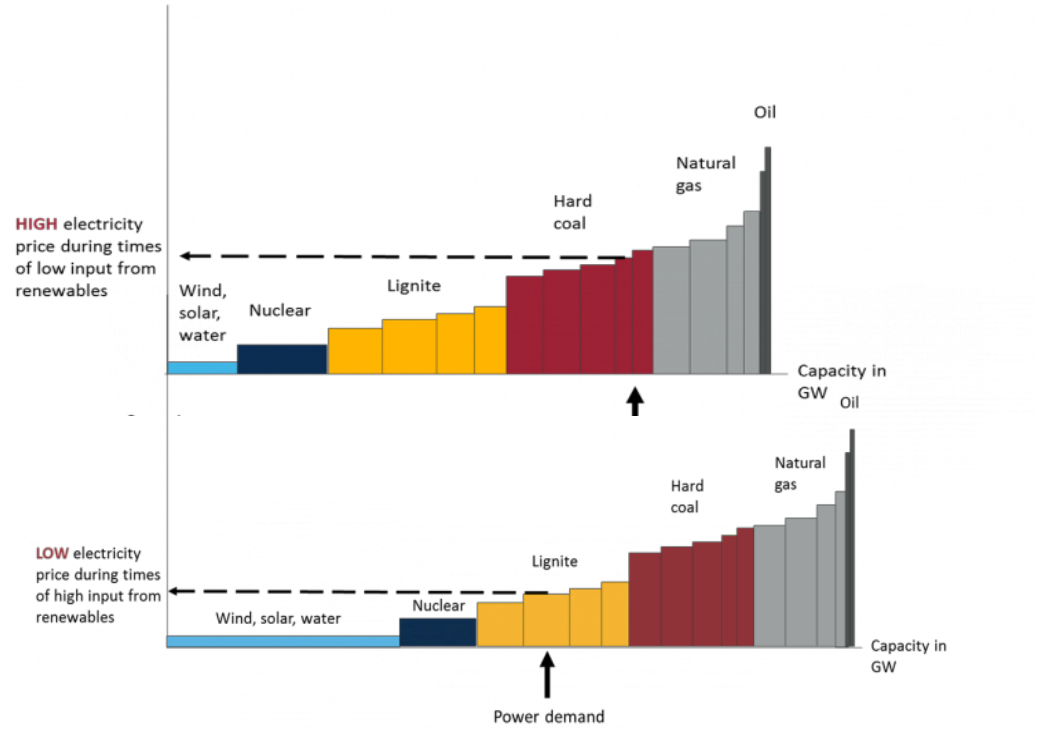
Table 5: *Top-10 Country Renewable Legislation Screening*

Country	No Retroactivity	Type of support	Comments
Germany	✓	Feed-in tariff Loans, Subsidy	Ambitious energy transition project Biggest market for renewables in EU (194 Twh)
Netherlands	✓	Feed-in tariff Loans	€ 4 billion SDE+ Subsidy High growth in RES, especially wind & solar
Poland	✓	Feed-in tariff Loans, Quota	RES Law (1 January 2016) Certificates of Origin (20% energy from RES)
Denmark	✓	Feed-in tariff Loan, Subsidy	Cut on renewable support from new government Highly saturated market
Finland	✓	Feed-in tariff Subsidy	Stable market with limited room for new players
France	✓	Feed-in tariff	Nuclear-oriented Most legislation not translated
United Kingdom	✓	Feed-in tariff	RES subsidy cuts by as much as 65% Change of focus to nuclear/capacity markets
Sweden	✓	Subsidy Quota	Stable market with little room for new players
Italy	✗	Not analyzed	Not analyzed due to retroactivity
Spain	✗	Not analyzed	Not analyzed due to retroactivity

Selected scope

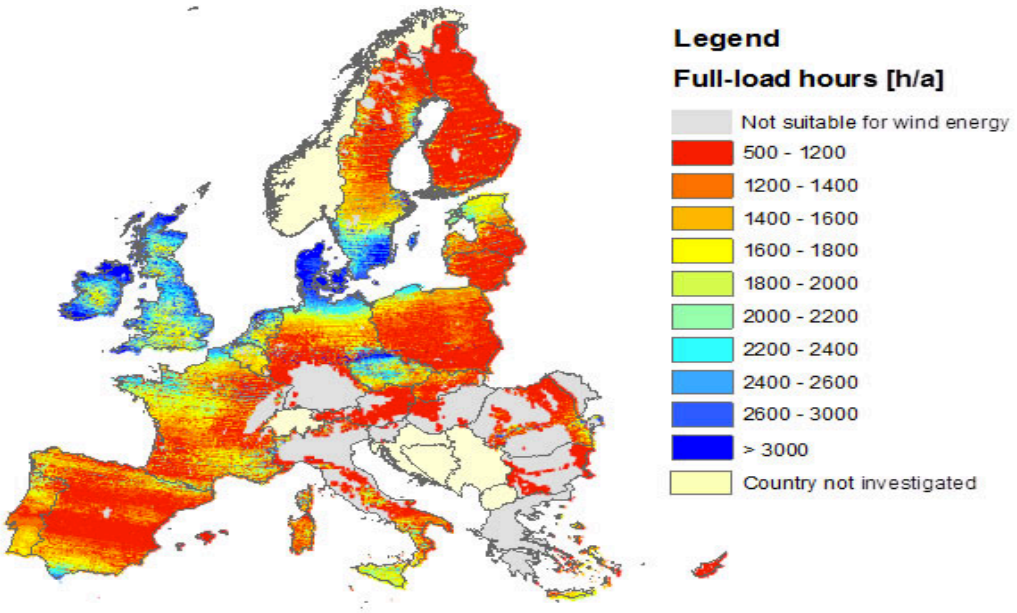
Source: (Res-Legal)

Figure 5: *RES and the Merit Order*



Source: (Eur-Lex)

Figure 6: *Wind Potential in Europe*



Source: (Held 2011)

Appendix B – Additional Notes

I - Energy Storage Project in Germany

Germany is the most developed Energy Storage market in the EU, had the first commercial battery storage system in Europe in September 2014 and are a development platform and export hub for energy storage being the first choice of companies who want to invest in the sector. In addition Germany has the second highest retail electricity prices in Europe which creates the particular need for the integration of this technology in the value chain.

Government Research & Development Support and world-leading research also make storage particularly interesting.

Six 15 MW Steag Energy Storage Projects were found across Germany, in Herne, Lunen, Duisburg-Walsum, Bexbach, Fenne and Weiher.

The overall lack of transparency and data on the Energy Storage Market in Germany associated with the profitability of the projects being deemed as too low led us to not analyse this option further.

II - Energy Service Company Acquisition in The Netherlands

The Netherlands has been amongst the leaders in Energy Efficiency in Europe for the last decade, with an Energy Efficiency Improvement Rate of 1.5%/Year from 2000 to 2014.

The country has an established ESCO Association: ESCoNetwerk.nl, which lists over 200 projects and 50 companies that provide energy services (Cofely, Strukton, Volker Wessels, Eneco, Honeywell, BAM Techniek, among other).

The highest registered efficiency was in the building sector with EPC with guaranteed savings being the preferred ESCO Contract in the Netherlands. Changes in the public procurement practices in recent years also favor ESCO projects, with the local and central governments choosing offers that produce lower life-cycle costs. Financial and fiscal schemes are also available for both the owners and implementers of energy efficiency projects.

After careful analysis of the available annual reports of the companies we found that most them did not have energy services as their core business but being a small partition of a company or conglomerate to big for us to acquire (Examples of Cofely – part of Engie or Honeywell or BAM, both billion-dollar revenue companies).

Companies that had energy services as their core business in The Netherlands were either constantly showing losses or too small, therefore this option was not analysed any further.